



RECENT EXPERIMENTAL INQUIRIES

INTO THE

NATURE AND ACTION OF ALCOHOLS AS FOOD.

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I have undertaken to ask you to consider to-night the subject of alcohols, in the belief that no other is more worthy of your attention, for it is one in which all are interested, both as individuals and as members of a community. The moral, physical, intellectual, and monetary character of a nation is as certainly bound up with it as is the health, domestic comfort, and social status of its individual inhabitants; and perhaps there is no other single subject of which this could be so truthfully said.

I am also induced to take this step because I feel that there is much error in the opinions held both by those who support and those who vehemently oppose the use of alcohols, which it is desirable to correct so far as increasing knowledge may enable us to do so; and, as a further plea, I may mention that science is now setting aside some of the views which she has hitherto promulgated, and is adopting others which seem by recent experiments and inquiries to be better founded.

I am, however, fearful lest you should have become so familiar with the subject and so impressed with the irreconcilable opinions which you have heard expressed, that it may no longer interest you; but although it is thousands of years since its evils were first known and protested against, and throughout intervening ages it has had great nations as its admirers, and equally great communities as its pledged objectors, it does not show that the subject is now exhausted, but only how much truth lies on both sides.

In taking it up in a simple spirit of truth, and without any known bias in either practice or pledge, to draw us unduly in either direction, I trust that we may find that a new consideration of the action of a substance of the most general use, upon which an incredible amount of money is yearly spent, both by the poor and the rich, which has potent powers most liable to abuse, and about which there is so old standing a difference of opinion, may not be without advantage. The subject is however as vast as it is important, and has so many ramifications which should interest us, that it is necessary *in limine* to make a selection, and to lay down defined limits for the evening's discussion. There are many here who look upon it in a national, others in a moral, and others in a social point of view, and who could doubtless treat it in these respects much more

efficiently than I could; but there is one question which clearly underlies all others—one which must guide all others, and to which I have given a prolonged attention, which may be sufficiently discussed in the brief space of time allotted to us, viz., the nature and the mode of action of alcohols. If we could arrive at correct and extensive views upon this question we should certainly have greater unanimity of opinion in reference to the larger bearings of this subject—unanimity and truth where there are at least seeming diversity and error—an object which is the end of all inquiries.

The plan, therefore, which I propose to adopt, is to consider, in as few words as possible, the three prime articles of belief amongst scientific men, and then to append a few subsidiary observations which naturally associate themselves with the principal subjects.

The three statements for discussion are the following:—

1. That the presence of alcohol in the many members of the class of alcohols gives a common character to the whole, and is the efficient agent in their action.
2. That alcohol is consumed in the body, and produces heat.
3. That alcohol lessens the waste of the body.

These will embrace the leading points, both in the scientific and the popular knowledge of the subject.

1. The assertion that alcohol gives a common character to and is the sole efficient agent in the members in the class of alcohols:—

In expressing my disbelief in this first statement, I do so with confidence, for I can appeal to the common practice of mankind - to facts with which every one is familiar, and which, however much they may have been disregarded, disprove the assertion in the most infallible manner. The practice of mankind is instinctive, and therefore based upon truth, whilst the researches and reasonings of men need correction, and hence the former is the test by which the truthfulness of the latter must be judged.

If alcohol be the efficient agent in alcohols, why is it that, after so much experience, we have not been induced to use pure alcohol alone, and dilute it to the extent

to which we dilute strong spirits, or in which we find it in wines and ales? This would surely be the readiest and the most rational procedure. Why is it found that new whisky is avoided by our northern neighbours, who are the best judges and most unsatisfied consumers of that liquid? Why are new wines discarded by the intelligent members of the neighbouring clubs in Pall-mall, seeing that they contain more alcohol than is found in older samples? Why does the hot whisky, strong in alcohol, which on the banks of the Ohio is sold at a few cents. per gallon, make the poor Red Indian (to whom it is bartered) frantically and furiously mad? Or, why will the raw whisky and the rough strong common wines sold in this country, give headache and general derangement of the system in the morning, when greater quantities of what are called purer spirits and wines might have been drunk with impunity? Why, do we, in selecting our wines, watch the oil trickling on the sides of the wine-glass, and carefully seek for a fragrant, full-bodied aroma, which gives us more pleasure than even the tasting of the wine? Why does the price of wine differ so greatly, apart from the amount of alcohol which it contains, and apart also from the supply of the wine or the year of its age? Why are the wines of certain vintages preferred to others? and, in general, why are vintage wines preferred to mixed wines? These are matters of hourly observation and of universal practice, and there must be valid reasons for them.

Why, again, do we object so strongly to the rough raw spirit which is found in the Cape wines, and why the objection which has recently been taken by the French Government to the use of inferior spirit in the manufacture of Cognac? Why, indeed, do we use the term "inferior" spirit at all if the amount of alcohol be the only test of its value? Why, again, do some persons prefer spirits, others wines, and others ales; and why is there so infinite a variety of tastes on such minute matters? The instinctive experience of mankind has pointed out the quantities of each which will produce an effect upon the consciousness, for whether it be one glass of spirits and water, or one to two pints of ale, or half a bottle of wine, it will contain the same quantity of alcohol, and hence these are recognised as the proper limits of a moderate drinker, but why the diversity in the choice, if the alcohol be the efficient agent?

Then, again, see the amount of popular knowledge as to the effects of these various substances, all of which, when taken in the usual dose, contain the same amount of alcohol. Let us take men who drink these fluids, but who are sober men, and can we not distinguish the gin-drinker from the beer-drinker? The former is a pale, haggard, emaciated, feeble, morose, creature, whilst the latter is a man of full habit, florid, and more genial. Then where shall we range the brandy and rum drinkers? It is well known that in the West Indies the decanter of fine old rum is kept upon the side-board, and any one entering the room may take a quantity diluted with water at any time of the day; and notwithstanding this he looks healthy and is hearty; but let a man, thus accustomed to rum, begin to drink brandy, and within a few weeks his friends perceive the change, from his altered aspect and manner. Why is rum the grog of our sailors, and of those of all civilised nations? Surely in America at least whisky can be made most abundantly and at a less price than rum; and although rum was introduced into the Navy as being the cheapest spirit, it is probably not so now. What would be the effect upon our jolly, care-nothing, muscular sailors, if they were supplied with gin instead of rum, but to remove from them the hearty aspect of the ale-drinker, and give them the appearance and strength of the emaciated wretches who haunt the corners of the streets?

We not only select, and that with the greatest nicety, the various kinds of alcohols which we prefer, but the effect upon the feelings, the aspect and the health of the system differs with each member of this class. This is popular knowledge and practice—based upon instinct rather than upon reason; for if you ask for the reason, the only answer you can obtain is the instinctive one that

"I like it best," or "it agrees best with me." It is not a question of how much alcohol is contained in these substances (except within certain limits), and yet on scientific grounds the rational distinction should be the amount of alcohol.

Neither is it altogether a question of taste, for if it were so we might turn to a body of gentlemen who are not reputed to care much about the taste of the agents which they employ, and ask why the medical practitioner does not give alcohol alone in the cases in which he judges it right to administer some member of this class. We know that he does not do so, but on the contrary selects with the greatest care that member of the class, which in his judgment is especially fitted for his case and will direct you as to even the kind of ale which you should take, and attach great importance as to whether you must drink port or sherry wine, when each will contain, as he knows, the same amount of alcohol. In doing this he is partly guided by his instinct, for it is commonly alleged that medical men recommend that which they like themselves, but it is in other parts based upon reason, for he has seen different effects follow their use.

In asking you to reflect upon these various questions may I not assume that it is clear to every one, almost without consideration, that men do recognize the fact that there are other important agents in alcohols than alcohol; and is it not probable that alcohol has attracted the chief attention of both scientific and non-scientific persons, because of its power to affect the consciousness, whilst the effects of other agents are less prominent? It is also true that whilst alcohol may be readily obtained from alcohols, and its presence proved by certain physical properties, the other agents have been but very imperfectly studied, and at this day are classed under the general expressions of volatile oils and ethers.

That alcohol itself is not a simple and uniform fluid, is known to every distiller, for whilst the finest is produced early, and is used in the manufacture of scents, and the next quality is, or should be employed in the manufacture of brandy and gin, and used in medicine, the product of the last hours of distillation is consigned to the makers of varnish. It is true that the first samples contain more alcohol than the latter ones, but that is not the real distinction. The flavour varies with the hour of distillation, and at the end a large quantity of fusil oil and free acid is found mixed with the alcohol as it leaves the still. The effects of the fusil oil have not been determined, but it is known to be one of the substances found in all raw, rough spirits, which produce headache.

Hence there is a practical but unexpressed belief that, however important alcohol may be in the various members of the class of alcohols, there are other substances associated with it of no less importance.

This quite accords with the results of my own experiments upon the human system, for I have shown that alcohol alone, and each member of the class of alcohols, has its own degree and even kind of action.

The plan which I have adopted in these inquiries has differed from that pursued by my predecessors, in the following particulars:—In former inquiries the substance was taken in doses unusually large or unusually frequent, and with various kinds of food, also at different periods of the day, and with varying degrees of exertion, and hence it was very difficult to dissociate the influence of the other agents from that under inquiry, and even yet more difficult to obtain a standard with which to compare the results. With a view to avoid these difficulties, I selected the morning time, before breakfast, for the inquiry, when the system was very sensitive, and when no influence of food existed; and by making the experiments in perfect rest, it appeared that all interfering agencies were removed, and the effect of the alcohol was perfectly isolated. We also obtained a correct standard with which to compare the result, viz., the amount of chemical change which occurred immediately before the fluid was taken. Hence, as the methods of inquiry have differed so greatly, it can-

not surprise if the results obtained should differ also. The direction of my inquiries has been that of the effect of alcohols over the respiratory functions, and the diagrams which are on the walls exhibit the results at which I have arrived.

ALCOHOL itself, when taken in doses of 1½ oz. (a small wine-glass full), diluted with 6oz. of cold water, almost always increased the amount of carbonic acid evolved, but only in a very moderate degree; the greatest increase varied from about half a grain to one grain per minute, but the average increase during the inquiry was from one-eighth to one-half a grain per minute. When a small dose (half an ounce) was repeated every quarter of an hour, the effect was more uniform.

RUM had a similar but a more decided action, for in one experiment there was an increase of two grains of carbonic acid per minute upon one of the persons; when repeated in small doses its action very much resembled that of alcohol.

BRANDY and GIN, in nearly every experiment, lessened the amount of carbonic acid expired, and the latter to the remarkable extent of nearly 1½ grains per minute in one experiment. The diagrams exhibit much variation during each inquiry, and upon different persons—but the general results were as just stated.

WHISKY varied much in its action, notwithstanding that in this, as in all other inquiries, we drank alcohols of more than average quantity. Generally, it lessened the respiratory changes, but with a very manifest tendency to return to, or to exceed, the latter quantity.

WINES, when taken in doses of 3oz., without water, produced but little effect, but commonly there was an inconsiderable increase.

OLD ALE and STOUT, in half-pint doses, always caused a sustained increase of about ¾ gr. per minute for about two hours, and although the general effect was less than that of rum and milk, it was (in the small quantities just mentioned) greater than that of alcohol or wine.

We investigated the action of the aromas of fine wines and spirits, by inhaling them, and in every instance found that they lessened the respiratory changes, but how far this might be due to a local action on the lungs, by their direct application to the surface, we cannot tell.

From these experiments it is clear that alcohols have an influence over the respiration—that this is diversified with the substances employed and the persons experimented upon, and that the effect of alcohol does not measure the effect of all alcohols. Hence we have proof that there must be other active agents in them than alcohol, and must call in the aid of the chemist to investigate more closely their composition. The uniform and conservative influence of the aromas of wines illustrates well the value which is attached to age in wines—a condition under which alcohol is lost and aroma gained. It also attaches an importance to the evil of manufacturing wines much higher than that of a mercantile fraud, for such composition cannot have this truly essential quality of wine when acting upon the system—an action, it will be observed, the reverse of that of the alcohol. I need not remind you that although we do not know the chemical composition of the aromas of flowers, we know that they are powerful agents. To many the scent of the rose, and the jasmine, and the wall-flower is very exhilarating, but to others it causes faintness; and in all persons the continuance of the influence is very apt to produce headache; whilst various chemical preparations emit odours of even a fatal tendency; and hence we need have no *prima facie* difficulty in believing that the choice, full-bodied aromas of wines exert considerable influence on the human system.

Beers contain two substances, in larger quantity than is found in wine, which we have shewn to have the effect of increasing the respiratory changes, viz., sugar and gluten. The diagrams show that sugar has an influence which is great and rapid, both in its rise and fall, while gluten acts moderately and with great uniformity. The degree of action of the former is greater than that of beer, whilst

that of the latter is very similar to it. I have elsewhere endeavoured to show that this action upon the respiration is not direct, but it is clear that the gluten, at least, causing the loss of more carbon than it supplies, must have the power of promoting the digestion or ultimate transformation of other food. Hence it will appear that the difference in the actions of beers from spirits, and of wines from alcohol, may be in part explained; and that instead of one, we have at our command a number of powerful agents, however imperfect our knowledge of them may at present be.

2. I now proceed to consider the second statement, viz., that alcohol is transformed in the system, and produces heat. The importance of this statement is that it is equivalent to affirming that alcohol is a true food, and with it is associated nearly all that physiology can say for or against its general use.

We may, in a few words, describe the grounds for the chemical view thus expressed.

There are two principal excretions from the body, one composed chiefly of nitrogen, and the other of carbon. There are likewise two great divisions of food taken into the body, one containing carbon principally and the other nitrogen, with a small amount of carbon. The body itself is composed of structures which contain nitrogen, as the muscles, and of fat which does not contain nitrogen but is rich in carbon; and lastly there are two prime processes in the system, by one of which, or the combustion of carbon and hydrogen, the body is warmed, and by the other, viz., the transformation of nitrogenous materials, it is nourished and repaired. Hence, then, it seems that the nitrogen taken in food is to be associated with the nitrogenous tissues of the body, and both are to pass out in the excretion of nitrogen, whilst the carbon and hydrogen in food are associated with the fat of the body, and both being burnt, pass out by the lungs as carbonic acid and water. The former class of foods, viz., the nitrogenous, have hence been called “flesh-formers,” and the latter “heat-formers.” Such is a bird’s-eye view of the general question.

Now alcohol consists of carbon and hydrogen with oxygen, and hence has all the elements of the one class of foods. Moreover it has a special attraction for oxygen, and when its elements unite with oxygen, whether in or out of the body, evolution of heat occurs; and as in respiration oxygen is introduced into the system, there is a presumption that it does unite with the carbon and hydrogen thus offered to its action. Then if to this we add the fact that starch, the basis of our farinaceous food, also composed of carbon and hydrogen with oxygen, is certainly united with oxygen in the system; and finally, that although alcohol is taken into the body, it has not been proved to pass out of it, we seem to have a demonstration that it is consumed in the system, and does cause the evolution of heat.

I do not stay to say that these theoretical views of nutrition are now undergoing a change, so that whilst the outlines may remain, it is probable that it will be shown that the distinction of heat forming and flesh forming matters is not so clearly marked as the theory assumes, but that the two kinds are mutually dependent upon each other. Neither need I advert to the fact that, as heat is produced from every chemical change, it will follow the conversion of nitrogenous as well as of carbonaceous compounds; but I will state the circumstances which militate against the view of the conversion of alcohols within the system:—

1. After alcohol has been taken, it may be obtained from some parts of the body, as the brain, in the state of alcohol unchanged for thirty six hours afterwards.

2. M. Lallemand, Perin, and Duroy have, within a few months, shown that alcohol may be detected in the breath, the perspiration, and other excretions for at least eight hours after a moderate dose has been taken. This is almost the “missing link” which all have sought for who have disbelieved the chemical theory, but it is not quite perfect. You will perceive, from the experiment now before you, that my friend, who took 1½ ounce of alcohol half an hour ago, by breathing through this solu-

tion of the bichromate of potass, in strong sulphuric acid, causes the colour to change from red to green. This is the ground for the statement just made. These French gentlemen have not procured the alcohol as such from any of the excretions, but they prove its presence by this reaction; neither have they been able as yet to show that the quantity of alcohol which thus leaves the body is proportionate to that which entered it. The value of the test rests upon the fact that no element in the respiration, when alcohol has not been taken, will produce this change; and that no transformation of alcohol—as, for example, into the allied substance, aldehyde—will cause it; and as these facts are said to be true, it is affirmed that the change must indicate the presence of alcohol in its own form and properties. This is a new and most interesting discovery; and, although its results are not complete, and require confirmation, I ask you to bear it in your memories. The above authors proved the transpiration of alcohol from the skin of a dog, but I am happy to have the opportunity of showing you an experiment, which has never before been performed, namely, the enclosing in an air-tight bag the arm of a gentleman who had previously taken $1\frac{1}{2}$ oz. of alcohol, and passing a current of air through the bag into the above-named test liquid.

Hence we seem at once to have cut the ground from under the feet of the chemical theory which previously appeared to be so conclusively established, and have proved that alcohol is not transformed, does not produce heat, and therefore is not a food. But long before this demonstration appeared, my experiments fully convinced those of us who were experimented upon that alcohol is not a food. The volatile elements or aromas with which it is associated in wines and spirits could be perceived in the excretions, and an alcoholic smell is well-known to exist in the breath of those who have drunk alcohols. Its mode of action upon the general system was not in the least like that of a food. The diagrams before you, although showing the general results upon the respiration which I have described, show, at the same time, how much difference in the degree of effect was found in each experiment of the same series, instead of the uniform and steady increase and decrease which mark the action of true foods. It did not in any degree satisfy the appetite, or give that sensation which marks the supply of nutriment. It is true that heat was felt after taking alcohols, but after a short time the sensation of cold was even greater—a sensation often sudden and distressing, and both were quite apart from the temperature of the external air. During its action, there was at first excitement of the spirits, but from the first there was relaxation and want of tone, and indisposition to use the muscles. After the action upon the consciousness had subsided, there was none of the vigour and healthful warmth which are found at the same period after a meal, but languor, lassitude, *malaise*, and misery. I will transcribe the notes of the effects in one or two experiments, with the period at which they occurred after the introduction of the spirit, again reminding you that all the experiments were made upon an empty stomach in the morning.

After taking $1\frac{1}{2}$ ounce of alcohol in May, it is recorded as follows:—In 6 minutes, giddiness; in 10 minutes, violent inspiratory efforts and greater giddiness; in 13 minutes, more blood sent to the skin, as shown by heat, fullness, and swelling of the hands and face; in 15 minutes, very great giddiness; in 25 minutes, oppressiveness, heat and fullness of the head, whilst at the same time general chilliness, relaxation of the muscles, heaviness of the hands, indisposition to move a finger, and lessened power of controlling the muscles; in 23 to 28 minutes, there was the full effect; in 30 minutes we felt relieved, and there was a semi-cataplectic state, or one in which it was pleasant to leave the finger or any part of the body just where it might happen to be; stiffness of the forehead. In 43 minutes, consciousness quite regained, expiration still constricted; in 44 minutes, there was a sense of fullness at the top of the head; in 54 minutes, there was a sinking, unpleasant sensation at the stomach, and oppressed expiration, but mus-

cular control was regained; in 58 minutes, the inspiration was much less violent; and in 71 minutes, all that remained was an unusual sensation at the stomach, and tingling at the top of the head.

A friend, who was also experimented upon, recorded that the skin was dry, as if exposed to an east wind.

In another experiment with fine old rum, taken in April, the effect was noted as follows:—

In 4 minutes, slight giddiness; in 8 to 13 minutes, dryness, and soreness on the tip of the tongue, lessened muscular power, stiffness of the face and hot hands; in 15 minutes, talkativeness and merriness; in 20 minutes, dreaminess; in 25 to 30 minutes, a purring or continuous buzzing sensation through the whole body, and a pumping sensation in inspiration, as if the quantity of air inspired was really greater than it proved to be. About this time was the greatest effect; the expiratory power was enfeebled, and the skin was hot, harsh, and dry. My friend was happy and hilarious, with his good-natured face glowing like a fire, beaming with happiness, and tears trickling down his cheeks; in 42 to 47 minutes, the influence was a little lessened, the inspiration perhaps a little shorter, and the influence upon expiration was increased; in 50 minutes we became, first, more taciturn, and then miserable; in 56 minutes, the influence was greatly lessened; in 61 minutes, a general sensation of cold; in 85 minutes, the consciousness was clear, but in two hours the effect had not passed away.

Now, apart from all other questions, may we not remark how different are these results from those following a meal of ordinary food; and were we wrong, think you, in stating that alcohol is the great, not alimenter, but disturber of the system?

We certainly arrived at the conclusion that it does not in any way act as a true food, that it does not produce heat by its transformation, and that it passes out of the body as alcohol or some very analogous compound.

But the fact remains that during a period in the action of alcohols there is increased sensation of heat. This may arise from either of three causes, viz., 1st, Increased production of heat whilst the rate of dispersion is constant; 2nd, Diminished rate of dispersion whilst the rate of production is constant; and 3rd, Simply increase in the amount of blood sent to the skin—the only organ by which in health we are cognizant of temperature.

In reference to the 1st, we remark that no thermometric proof has been given that during the action of alcohols the temperature of the blood in the central parts of the body is increased. As to the 2nd, it has not been proved that the dispersion of heat is increased, as might be shown in the effect of the radiated heat upon surrounding substances as ice; but on the contrary, it is highly probable that the dispersion is diminished. The dispersion of heat takes place both by radiation and evaporation; by radiation as if it were merely inanimate matter, but by evaporation as a living organism; and it cools by the absorption of heat as the fluid becomes converted into vapour. The freer the perspiration or the evaporation the cooler the body becomes because vapour absorbs and renders latent 1,000 times more heat than was held by the volume of fluid from which it was derived. We have just shown that the skin is commonly dry and harsh during the action of alcohols, and as that is a state the opposite of that in which free evaporation or perspiration occurs, it follows that it is one in which there is lessened transpiration and consequently lessened removal of heat.

The third condition is one mainly dependent upon the force of the heart's action, by which the current of blood is driven to the surface; and there can be no doubt that in the hot stage of the action of alcohol, the heart's action is increased. This will give increased sensation of heat, by bringing more warm blood to the skin, and, at the same time, will increase the dispersion of heat in any climate in which the temperature of the surrounding air is less than that of the body.

Hence we conclude that, whilst there is a temporary

increase in the sensation of heat during the early action of alcohol, there is no proof that there is an increased production of heat; but it is more than probable that there is diminished dispersion of heat and the result is therefore temporarily the same. Alcohol does not produce, but it saves heat. It is not transformed, and it is not a true food.

In this action all alcohols act alike, for it is due to the alcohol alone.

3. We have now to consider the third statement, viz., That alcohols lessen the waste of the system.

Now, assuming this to be so, do we well understand what it means? It is assumed, on the face of it, that by lessening the waste the system gains, and that the gain is an advantage. But health means a due balance between want and supply, and if you lessen the waste you should at the same time lessen the supply, or you will have the evils of excess; and if you lessen both the waste and the supply, it follows that you have lowered the vital actions below that amount which constitutes health. There must be a certain fixed amount of vital action to maintain life, and there is always a further variable quantity to enable us to fulfil the active duties of life. To save waste, therefore, in health and with due supply, is to induce disease. Now, as to the fact of there being diminished waste during the action of alcohols.

It has been affirmed, on the testimony of many observers, that alcohols lessen the amount of carbonic acid evolved; but if, as the same authorities state, the alcohol is consumed and converted into carbonic acid and water, why have we not an increased instead of a lessened evolution of carbonic acid? The two statements nullify each other. I have elsewhere pointed out the sources of error in these statements, and shown that they are due to inferring total amounts from mere percentages, as in Prout's experiments; from mixing up other influences with those of alcohols; from inferring large quantities, as those of a day, from observations occupying a minute; from the natural variations of vital action during the day not having been then known; and from believing that one kind of alcohol represents the whole series. To-night I have stated to you that some alcohols do lessen the amount of carbon expired whilst others increase it; but it will be observed that the effect, in either direction, is but small, and that alcohol, by its action upon the heart, apart from its own transformation, may in a small degree excite the vital actions and thereby slightly increase the excretions.

It is also affirmed that, under the action of alcohol, there is less nitrogen, or urea, evolved, and this seems to have been established by many experimentalists, among whom I would mention Hammond, and thence it is asserted that the muscular tissue of the body is saved. Now, I beg of you to understand that the connection of urea with muscular tissue is far less established now than it was years ago, and I have shown, by recent experiments at Coldbath-fields prison, that, in the absence of food, the labour of the tread-wheel (which is surely muscular action enough) does not increase the evolution of nitrogen, or urea. But however this may be, there is a connection between urea and food, and we cannot read Hammond's experiments without seeing the fallacy upon the face of them. He was living at a border fort of the United States Government, with a medium temperature of 73° in the shade, and ate from 16 to 22 ounces of flesh, 18 oz. of bread, 6 oz. of soup, 4 oz. of beets, 1 oz. of butter, &c., per day, and he records the following statement:—

"Whilst the experiments were progressing, the healthy action of my system was much disordered. Headache was constant; sleep was disturbed; the skin was hot; pulse full and bounding, averaging 98 per minute; and there was on two occasions, after eating, a slight palpitation of the heart. My appetite was capricious. Sometimes disgust was created by the mere sight of food; at other times I ate with a good deal of relish. I think I should have been seriously ill if I had continued the investigation longer."

Surely, here we have an abundant explanation of the diminished urea or nitrogen, which he discovered, not in that the alcohol lessened the waste of his tissues, but that it made him ill. The food which he took was not digested and transformed into tissue, but accumulated, and at length, after each experiment, induced a violent, but, as he says, salutary diarrhœa. In fact, whilst eating excess of food, and perhaps gaining weight, he was starving his system, and there would necessarily be a less amount of the products of transformation.

This, I have no doubt, is the explanation of all such experiments, but it will vary as the system is able to rid itself of its dangerous disturber. In our prison experiments we found that alcohol lowered the excretion of the nitrogen at first, but on the third day the quantity regained its former level.

Hence, I consider it to be proved that if alcohols do lessen the waste of the system in health, they do it actual injury.

We have now cursorily considered the three statements proposed for discussion, and have shown:—

That the class of alcohols is a heterogenous one, both in its composition and action.

That alcohol is only one important element of the class. That the aromas of wines and spirits have a decided action, and constitute an essential part of the value of those substances.

That the gluten and sugar of beers are valuable agents in promoting the assimilation of food; and in proportion as wines contain the same elements they have a similar action.

Hence, there are three actions due to alcohols (apart from any questions of their use as foods) viz., the general stimulating and disturbing one of alcohol, the conservative one of the aromas, and the digestive one of gluten and sugar.

Alcohol is not a true food, and it neither warms nor sustains the body by the elements of which it is composed.

It lessens the dispersion of heat by lessening the action of the skin, and it increases the action of the heart.

When it lessens the excretion of carbon or nitrogen, it does so by disturbing the assimilative process, and thus, instead of saving, it starves the system.

I will now bring this communication to a close, by categorically stating a few facts which arise out of the preceding discussion.

1. Alcohol, although it is not a food, is a medicine, since it varies the intensity of the processes of the system, without being itself transformed and converted to the purposes of the body.

This is a fundamental fact, and when it is well understood, it will not be found difficult to define the conditions in which alcohol is useful and not useful, and I will now name a few of them.

Thus, when the want and supply of the body are duly balanced, and in proper amount, as in the ordinary condition of health, it is not useful, but, by disturbing the balance of the vital actions, may be injurious.

When the vital wants are greater than the supply, or than the due transformation of the supply of food, the volatile aromas are useful.

When the whole vital processes are low, as in fatigue and debility, it is probable that alcohol may be useful.

When the powers of digestion and assimilation are deficient, it is probable that beer may be useful.

When, by exertion or cold, there is an unusual but temporary call upon the system, which cannot be responded to by suitable food, alcohol may be useful.

In hot climates, as India, when the system is enfeebled, when the skin is perspiring too profusely, and the powers of digestion and assimilation are deficient, it is probable that alcohols may be useful.

When, under the same conditions of temperature, there is not too profuse a perspiration, and the temperature of the external air is equal to, or higher than, that of the body, alcohols must be most dangerous.

Of two men living under the same external conditions, the one with a perspiring skin may take alcohols largely without danger, so long as the skin perspires, but the man who has habitually a dry skin must avoid them.

In cold climates, where the powers of transformation of food and the supply of food should be very great, the free or continued use of alcohol must be dangerous. This has been affirmed to be true by Dr. Rae, and is the experience of many northern navigators.

Lastly, In young persons, in whom the supply of food should be excessive, in order to maintain growth, the constant use of alcohol may be very dangerous, and prevent growth.

Such are a few of the medical requirements of alcohols, apart from actual disease.

2. Although alcohols are not foods, and cannot supply the place of foods, they cannot be dispensed with, but should be prescribed medicinally and as carefully as any other poisonous agent.

3. The English are so notorious for their love of medicine as to be designated a nation of quacks, but yet it is not sufficiently appreciated that, whilst they pay only some five or six millions a year to the whole medical profession, they spend sixty millions yearly in the purchase of this one drug.

4. The habit of wine drinking is in part due to the evil of late dining. In other experiments, I have shown that all the vital actions of the body decline in the evening, and hence, at that period, the appetite needs the stimulus of artificial food; and alcohols are then more requisite and exert less influence. If, as a nation, we would avoid the use of alcohols, we must distribute the food more largely in the early, and less plentifully in the later, parts of the day; for, at the former period, the system has greater necessity for it, can more quickly digest it, and has then a more simple taste for it. In doing this, we need not revert to the old-fashioned suppers, but with plenty of food taken early, tea and coffee will suffice for the later meals.

Alcohol drinking is one of a connected series of evil habits. To remove one, we should lessen all.

5. The manufacture of beers and their use in India, are national questions.

If the action of ales be as above given, of what value, we may ask, are the bitter beers of the day? It is true, that they have done well in supplanting the alcohol of the strong, old-fashioned ales, but they have not done well in having given strychnine or quassia water, for sugar

and gluten. They are grateful, but they are comparatively useless, except as bitters, and induce a vast waste of money.

If ales be taken, not as alcoholic compounds, but as digestives, then the good, full-bodied malt and hop ales, now gone out of fashion, are required; and these would be more useful when drunk in quantities of wine or ale-glasses full, than in large volumes from our pewter pots and glass tumblers. Let those who would drink ales rationally, select the best quality, and drink them as they would drink rich and full-bodied wine, and such a course, if generally adopted, would be an effectual temperance movement.

The introduction of strong ales into an Indian climate, is opposed to all that nature teaches us, and whilst medicinally, (and therefore in numerous selected cases) they may be useful, as ordinary dietetics, or for any large body of men indiscriminately exposed to great heat, they must be most injurious. The only valid excuse for our conduct is that drinking ale is a less evil than drinking arrack.

In this matter we are in truth pandering to one of the failings of an Englishman—that of taking England with him into every climate; and I cannot but fear that this act of our government is as dangerous as it is scientifically indefensible.

Lastly, there is a wide-spread conviction, still existing amongst our working classes, that they cannot do without their beer, and so far as it is based upon truth it implies that this is necessary to the digestion of the starchy food with which so many are obliged to be content; but it is chiefly based upon the fallacy that the comfortable sensation which they experience after drinking is indicative that beers nourish them. In a large hospital experience, I am unable to convince the poor washerwoman, and even the man who has no resources, that 2d. spent in milk will do far greater service than when spent in ale or gin. No doubt it is easier to do without these stimulants when there is abundance and variety of food, warmth and pure air, all of which are still lacked by a very large proportion of our community, but when the working classes shall truly understand the exact value of alcohols, we need not doubt that we shall soon find even the sober man better fed and housed. But habits of temperance and economy are high up in the social scale of duties, and the temperance movement amongst the poor and ill-fed will be successful in proportion as it is associated with all other efforts tending to the religious and social elevation of our race.

